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ABSTRACT

This report discusses the progress in the development and clarification of the term "environmental literacy" (EL) and suggests ways in which the term may be used to advance the field of environmental education. Part I presents the evolution of EL beginning with a description of the concept as a goal of general education. Discussed in this section is the concept of literacy in general, scientific and environmental literacies, and the essence of EL. The section concludes with a summary of the evolution of the term "EL" from 1969 to 1989. Part II presents a description of the operationalizing of the concept in four sections: (1) refining and clarifying the definition of EL in the 1990's; (2) an EL continuum; (3) stages of environmental literacy; and (4) levels or degrees of EL. The specific aspects of the three major levels, nominal EL, functional EL, and operational EL are described. The third and final part explores directions for the 1990's and includes questions concerning: whose responsibility it is to stimulate and nurture EL; EL and Higher Education; and assessing EL. The appendix lists terms and concepts that environmentally literate citizens should understand. (38 references) (MCO)

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Environmental Literacy

Its Roots, Evolution and Directions in the 1990s

Charles E. Roth

Education Development Center
Newton, Massachusetts

September 1992

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ERIC Clearinghouse for Science, Mathematics and Environmental Education
The Ohio State University
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Columbus, OH 43212

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Foreword

The concept of environmental literacy first appeared in an article by this writer in *Massachusetts Audubon* in 1969 (Roth, 1968). I wrote the article in response to the then frequent media references to environmental illiterates who were polluting the environment. Stating that it seemed relatively easy to determine who was environmentally illiterate, I posed the question "How shall we know the environmentally literate citizen?"

Essentially that question was posed to a number of national environmental leaders in science, in politics, and among environmental activists and educators. Relatively few responses were received but based on these and my own perceptions the article was prepared for Massachusetts Audubon (Roth, 1968), then the magazine of the organization with the same name. Shortly after the article appeared it was reprinted in part in a Sunday edition article of the *New York Times*, (Faust, 1969), but relatively little more attention was given to it until a year or so later when the term "environmental literacy" appeared in several speeches by President Richard Nixon that related to the passage of the first National Environmental Education Act. The term was entered into the speeches by a federal bureaucrat and speech writer who had read the Times reprint of the article and had worked with me on various aspects of environmental education.

My initial definition of environmental literacy went through a number of refinements as it became the working goals concept for the Liberty Council of Schools Environmental Education Project—a Massachusetts multi-community education collaborative developed under an ESEA grant. It later was further refined as a key goal statement for the Massachusetts State Plan for Environmental Education that was funded in 1972 under a grant from the National Environmental Education Act (Task Force, 1972).

As time passed, the term "environmental literacy" crept further and further into the vocabulary of environmental educators. Indeed, it became common to state that development of environmental literacy was the primary goal of environmental education. Unfortunately there became almost as many perceptions of the nature of environmental literacy as there were people who used the term. Most had never read, or heard of, the original article and were not using modifications of it as a basis of their own concepts of the term. The result has been that the term became used in so many different ways or was so all encompassing that it had very little useful meaning.

In the two decades that have passed since the term was coined, our knowledge of both the environment and how people learn has increased phenomenally. Our society today is clearly in transition from an industrial society to some form of post-industrial society. Some have described that post-industrial society as a service or technological society. Roger Bybee (1979a) argues that it should be referred to as the Ecological Society. He contends that ecological society is a more encompassing paradigm "which certainly uses technology of appropriate size as a means to solving human problems, not as an end in and of itself." Such a societal paradigm, which is both conserving and sustainable, has a number of characteristics. Bybee suggests that a few of these of importance to educators include:

1. Population growth will be stabilized
2. Growth will not be contingent on the rapid depletion of non-renewable resources.
3. Per capita consumption will not substantially exceed that which now exists in the United States.
4. Pollution of all types will be reduced.
5. Economic growth will emphasize human services.
6. Agricultural output will increase with attention to maintaining soil quality.
7. Social goods and services will be distributed with greater justices. (Bybee, 1979a).

Although to get to such a state, as Robert Frost suggests, we still "have miles to go before we sleep," there is a heightened awareness of the need for environmental education for our citizens and progress in providing it. Yet we are still relatively vague about what it is that we are trying to do through environmental education.

In the 1990's, as the field of environmental education has grown and increasingly matured, ever more people have undertaken to revive the usefulness of the term environmental literacy by clarifying and redefining its meaning. At the urging or the Federal inter-agency Committee of Education's Subcommittee on Environmental Education, the American Society for Testing and Materials (ASTM) established a committee to develop consensus standards on Environmental Education. One of its primary working committees is one on environmental literacy with the objective of clarifying and redefining the term.

With such a clarified definition and goals in hand, we will all be better able to evaluate the potential of proposed programs to achieve the goals and to determine the degree to which existing programs are succeeding. We will be able to determine cost effectiveness and better promote the broader acceptance of environmental education in the overall educational system.

The purpose of this monograph is to summarize and elaborate on progress to date in the development and clarification of this key term for environmental education and to suggest ways in which the term may profitably be used to advance further the field of environmental education (or environment education as some prefer to call it today (Charles, 1991). In the monograph we will deal with the following questions:

What purposes will environmental literacy serve to society?
Who should be environmentally literate and to what degree?
What knowledge, skills, and attitudes are needed in order to be environmentally literate?
Why are those specific knowledges, skills, and attitudes necessary?
How can environmental literacy be assessed?

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Part I: Evolution of a Concept

Environmental Literacy as a Goal of General Education

A major purpose of education is to provide people with the knowledge and skills to allow them to live successful, productive lives and to function as responsible citizens within society.

Since:

- All sustainable human activities are dependent upon a clean, healthy, and productive environment.
- It is the environment that provides the materials and energy to meet our basic needs and desires.
- The nature of particular environments sets parameters for many human activities and establishes risks for those activities;
- All human activities have consequences for the environment both positive and negative;
- The quality of our environment at any given point in time is the net sum of the consequences of individual and group actions;
- People have the capacity, and generally the opportunity to make individual and group choices among alternative behaviors and technologies and to assess risks;
- Much of the environmental degradation that has occurred in the past, and continues today, is the result of the failure of our society and its educational systems to provide citizens with the basic understandings and skills needed to make informed choices about people/environment interactions and interrelationships. Environmental degradation is often the result of thoughtless activity of most economic systems operative today.
- Environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems;
- Developing environmental literacy is the primary goal of environmental education, with the objective of fostering productive and responsible citizens of this planet and of our society;
- Schools have as a major objective the preparation of students to be productive and responsible citizens in our society;

Therefore:

- Although schools are only a segment of the overall education system of our society, they bear a significant responsibility for empowering our citizens with the requisite understandings and skills necessary for routinely making the choices that are part of our individual, personal life styles and citizen action.
- Developing such understandings and skills is not the province of some special discipline but draws upon a broad spectrum of disciplines over time, with the unfolding of developmental capacities.
- Developing useful levels of environmental literacy therefore requires regular and continuous involvement through the school years and beyond, and should be part of the basic core program of schools across the nation.
- The curricular goal and objectives are essentially universals; the instructional processes will vary, with varied effectiveness with specific audiences.
- **The development and fostering of environmental literacy needs to be a key objective of any general education program (Roth, 1991).**

As Richard Peters (1981) noted:

> Because environmental problems do not stop at national boundaries then we, as a nation and as a world community must control human population growth, better manage finite fuel resources, provide adequate quantities of food and water for various forms of life, conserve the world's forests, improve the quality of the atmosphere, and prevent the further extinction of plant and animal species.
>
> We must begin, now, to educate a generation of "quality environment" conscious people who will, in the routine of their everyday lives, continually and logically balance the interests and needs of nature and human populations whenever decisions regarding Earth's usage are to be made.

Those decisions are made daily by everyone in one of more contexts of their activity as consumers, producers, recreators, procreators, and voters. The ability to make those decisions and choices in a fashion that will permit a sustainable human society is dependent upon the degree of environmental literacy of each citizen. The degree achieved is largely a function of education and character development.

On The Concept Of Literacy In General

From its inception, there have been those who have questioned the use of the term "literacy" in association with anything but reading and writing. However the term has gone through considerable evolution of its own through the years. Michaels and O'Connor (1990) point out that until the late 1800s, there was no word "literacy." Venezky, Kaestle, and Sum (1987) inform us that according to the Oxford English Dictionary, the abstract noun "illiteracy" predates the word "literacy" by several hundred years. Perhaps it is not so strange then that the 1969 original cut at defining environmental literacy came after general references to environmental illiteracy. However, the original use of the term literacy did indeed focus on the ability to read and write.

Michaels and O'Connor (1990) observe that:

> Like other abstract nouns–"freedom,"" justice," and "equality"–"literacy" denoted a value to be espoused for the society as a whole. During roughly the same era, widespread and mandatory elementary public education grew to something like its present proportions. Educators, government officials and industrial leaders all began to see "illiteracy" as a social ill, and "literacy" as something that could be promoted throughout the populace. Literacy was a property of states or nations, not just individuals.

In today's world, the term *environmental literacy* serves a very similar function. Although literacy is a term that originally referred only to the ability to read and write, in recent years it has been extended in scope by the addition of a variety of adjectives—science literacy, visual literacy, computer literacy, cultural literacy, etc. Dictionaries generally give only two definitions:

a) Able to read and write.

b) Well educated, having or showing extensive knowledge, learning or culture.

It is essentially from the second definition of the term that the extended scope of the term has been created. Purists may well have trouble with this expanded scope of the term but it is given increasing credence by the work of cognitive science. Michaels and O'Connor (1990) state that:

> The cognitive science conception of literacy orients us to think about literacy as a tool for knowledge construction, a tool for learning.....Within cognitive science, literacy has been reconceptualized as reasoning or problem solving to generate new knowledge.

Michael Posner (1989) wrote:

> To learn a new field, according to the cognitive science approach, is to build appropriate cognitive structures...that will transform what is known into what is not yet known.

This has ultimately led to the idea of literacy as *multiple discourses* with the term *discourse* being used in a very specific and technical sense. Gee (1989) defines the use of discourse in this sense as:

> A socially accepted association among ways of using language, of thinking, acting, and of valuing that can be used to identify oneself as a member of a socially meaningful group or 'social network.

Picking up on this definition, Michaels and O'Connor (1990) make the following points that serve to set the stage for a broader definition of literacy that ultimately gives credence to the development of such ideas as scientific and environmental literacies:

> Beyond vocabulary and background facts, there are discourse-specific ways in which arguments are made, in which certain kinds of information must be foregrounded and used as evidence. There are discourse-specific ways in which you must infer connections or "get the point." Different discourses require very different ways of "reading between the lines"....Becoming literate in any particular domain involves learning a specific discourse—*particular ways of thinking, acting, valuing* [italics added].

> Literacy, conceived of as multiple discourses, is an inherently plural notion. We each have, and indeed fail to have, many different literacies. Each of these literacies is an integration of ways of thinking, talking, interacting, and valuing, in addition to reading and writing. Each literacy is always embedded in a particular social setting, whether family, community, school, or public institution, and a particular interactional context.... Literacy then is less about reading and writing per se, and is rather about ways of being in the world and ways of making meaning with and around text.

Thus, although literacy is a term that originally referred only to the ability to read and write, it has evolved considerably and is now legitimately extended in scope to encompass many different discourses by the addition of a variety of adjectives—science literacy, visual literacy, computer literacy, cultural literacy, etc. Unfortunately dictionaries still give only the two general definitions.

In this monograph we attempt, to define and clarify what it means to be "well educated" about the environment, that is, to be environmentally literate. That is, within

the diverse social components that comprise the contextual settings for our learning, we will look at ways of thinking and talking about, interacting with, and valuing, the environment and human interactional contexts with it.

Environmental literacy involves human discourse about inter-relationships with the environment. It is essentially the degree of our capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems.

It would appear that the absence or existence of degrees of literacy can best be determined by observed behavior, i.e., a child either can or cannot read; or the child can read not only simple signs but whole books. Environmental literacy should be defined likewise in terms of observable behaviors. That is, people should be able to demonstrate in some observable form what they have learned — their knowledge of key concepts, skills acquired, disposition toward issues, and the like.

Scientific and Environmental Literacies

In the late 1980s and early 1990s the United States' concern over the decline in science education and general citizen understanding of science and technology, matched by a decline in young people embarking on science careers, has led a strong push in the science community for fostering and nurturing widespread science literacy among our citizenry. Indeed, scientific literacy is stated to be a national goal (American Association for the Advancement of Science, 1989; Council on Environmental Quality, 1991). Actually the notion of *scientific literacy* began to surface in the 1950s and 1960s but did not gain ascendancy as a major goal of science education until the more recent era (Shamos, 1989).

The precise nature of science literacy remains a matter of debate in the science community. Although it has been addressed in a number of major national reports on science and science education, it remains a slippery concept. But it is evolving (Forenz, 1989). Shamos (1989), reflecting on the national science curriculum projects of the late 1960s and early 1970s wrote:

> For the vast majority of students not interested in scientific careers, some exposure to science had long been thought necessary both in high school and college, based on the theory that a discipline so prominent in human affairs deserve to be part of the general education of all students. But true scientific literacy, at least as I (and others) now view it, namely, understanding the principal features of the scientific enterprise, was not the real objective. Instead, the goal was equated somehow with "science for effective citizenship," that is, to develop an informed public capable of playing an intelligent role in science- or technology-based societal issues. Whatever the intended meaning of scientific literacy, which at the time was not clearly defined in an operational sense, it was believed that the new elementary school science programs might lead students toward this elusive goal

> more effectively than the traditional science (reading) programs then in use.

Miller (1989) worked to move away from earlier very general statements of scientific literacy to more specific yardsticks, at least in terms of adult scientific literacy. He identified three major components of scientific literacy:

1. An understanding of the processes or methods of science for testing our models of reality.

2. A basic vocabulary of scientific and technical terms and concepts.

3. An understanding of the impact of science and technology on society.

This still is a very comprehensive set of goals for most people; a set that it is unlikely they can reach. As Shamos (1989) remarked:

> Few educated individuals are totally illiterate in science; everyone knows some facts of nature and has some conception of what science is about, however naive or misconceived their opinions may be. Thus, it is an oversimplification to assume that one is either totally literate or illiterate in science. Instead one can distinguish forms or levels of literacy, levels that normally are attained sequentially by students in their formal exposure to science.

Shamos went on to identify and define three forms of literacy: *cultural* scientific literacy, *functional* scientific literacy, and *true* scientific literacy.

One of the most carefully thought out efforts toward scientific literacy has been set forth by the Project 2061 effort of the American Association For the Advancement of Science (1989). Its major focus is the development of "knowledge, skills, and habits of mind that all students should have acquired by the time they finish high school." The report states that scientific literacy embraces "science, mathematics, and technology." The recommendations address the "basic dimensions of scientific literacy, which include, in the most general terms:

- Being familiar with the natural world and recognizing both its diversity and unity.

- Understanding key concepts and principles of science.

- Being aware of some of the important ways in which science, mathematics, and technology depend upon one another.

- Knowing that science, mathematics, and technology are human enterprises and knowing what that implies about their strengths and limitations.

- Having a capacity for scientific ways of thinking.
- Using scientific knowledge and ways of thinking for individual and social purposes.

There is considerable overlap between scientific literacy and environmental literacy. To understand how they differ, it is necessary to have a basic understanding of the evolution and current direction of scientific literacy, thus the brief overview of scientific literacy presented above. The two not only have overlap but a considerable degree of parallel evolution. Bybee (1979b) included a significant set of environmental literacy concepts into his perceptions of scientific literacy when he wrote:

> The goal of science education should be to develop a science literacy that includes the fundamental relationship of individual human beings to the environment and to each others communities.

To my knowledge the social sciences community has not yet undertaken to define literacy in terms of the various social sciences. Thus it is not possible to look at how such literacy, or literacies, might be considered in terms of relationship to environmental literacy. One might speculate that such literacy might include such things as:

- A sense of place and understanding of the distribution of resources in space.
- A sense of time and understanding that all events have a history and consequences.
- Understanding of the fact that humans are social beings.
- Skills to interact individually and cooperatively to achieve social and political goals.
- Skills to derive goods and services from the environment to meet basic needs and desires.

Some of these, and others, will be seen to be components of environmental literacy.

The Essence of Environmental Literacy

Environmental education began to emerge as distinct field during the mid-1960s. It has its roots in variety of related fields–conservation education, nature education, resource-use education, outdoor education, geographic education, science education. It draws its strength from all of these fields but derives its focus from several basic issues:

- The interrelationships between natural and social systems.
- The unity of humankind with nature.

- Technology and the making of choices.
- Developmental learning throughout the human life cycle.

Whereas science literacy, for many people, seems to be built on a mechanistic paradigm, environmental literacy builds on an ecological paradigm. Environmental literacy is the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems.

Environmental literacy is a continuum of competencies ranging from zero competency to very high competency that can be functionally divided into three working levels—nominal, functional, and operational environmental literacy.

Developing environmental literacy at some level of competency is the primary objective of environmental education. To assess and evaluate the potential value and effectiveness of any environmental education program, that program should state, with considerable precision, the degree of environmental literacy competency it aspires to and the degree of environmental literacy that is assumed of those entering the program.

There is no doubt that environmental literacy draws upon many aspects of scientific literacy, particularly in terms of habits of mind. Both involve people in:

- Using critical and creative thinking;
- Seeking and organizing information;
- Being healthily skeptical;
- Thinking ahead and planning;

In addition environmental literacy involves people in:

- constantly seeking connections and interconnections between objects and events;
- Routinely looking for the seeds of change;
- Routinely evaluating the consequences of potential actions;
- Routinely examining alternatives and making choices among them;
- Constantly making choices among alternatives that have minimum negative impact on natural systems.
- Acting responsibly as one form of living thing among many diverse, interacting, and interrelated forms.

Environmental literacy extends beyond aspects of scientific literacy; environmentally literate people have aspects of economic literacy, geographic literacy and have or seek

historical understanding of how various environmental issues came to be. Environmentally literate people seek understanding of the historical background of the issues with which they become involved. This historical perspective is necessary "to promote awareness of differences and possibilities, and understanding of how things have come to be as they are and that they might have been otherwise. It must be used to enlarge horizons, to shake complacency, to stir the imagination" (Borrow, 1990). The environmentally literate have a knowledge of issues, knowledge of action strategies, a strong internal center for their locus of control, positive attitudes and a strong sense of responsibility (Hungerford, Peyton, and Wilke, 1981).

Environmental literacy draws upon six major areas: **environmental sensitivity*, knowledge, skills, attitudes and values*, personal investment and responsibility,** and **active involvement**. (*In descriptions of literacy level specifics later in this document, environmental sensitivity, attitudes and values are subsumed under the term "Affects," and personal investment and responsibility and active involvement are subsumed under behavior, thus creating four strands: **Knowledge, Skills, Affect, and Behavior**.)

People seldom think of literacy beyond certain cognitive skills. However, in the more modern sense of literacy as multiple discourses, as noted earlier, literacy involves particular ways of thinking, acting, and valuing. Environmental literacy is being defined in all these ways and may be somewhat unique among current definitions of particular literacies in doing this so overtly.

Evolution of the Term Environmental Literacy–1969-1989

The specific language has been refined a bit over the years to weed out sexist language, but in its last printed iteration the original definition from Roth runs as follows:

We might recognize an environmentally literate citizen as one who:

- Recognizes environmental problems when they arise. This means acquiring a basic understanding of the fundamental interrelationships among people and the bio-geo-chemical environments. Without such understanding the individual cannot perceive potential breakdowns in the system resulting from technologies and population density-dependent factors—breakdowns that reduce the quality of life and which could ultimately affect the ability of the biosphere to sustain life.

- Thinks before acting, examining as many facets of an environmental issue as possible before taking an action position.

- Rejects short-term gains when they threaten long-range benefits. The individual recognizes that environmental problems are easier to prevent or arrest than to reverse.

- Takes action to correct environmental imbalances through such approaches as:
  a. Altering consumer and work practices to make them ecologically sound.
  b. Expressing concerns and opinions to appropriate officials.
  c. Suggesting and/or writing and supporting appropriate legislation.
  d. Initiating and/or participating in group action and encouraging others to identify and take action on environmental issues.
  e. Supporting appropriate organizations with time and/or money.
- Continues to gather information about environmental issues throughout his life, recognizing that knowledge and skills once acquired cannot be expected to serve a lifetime in our rapidly changing world: yesterdays solutions may not fit today's problems.
- Is humane—that is, recognizing the ecological interrelationships of all living things, the individual extends the concepts of humaneness to other living things.
- Treats public property and the private property of others with the same respect and stewardship the individual extends to his or her own most revered property.
- Has a keen sense of stewardship, maintaining and improving the ability of his home area to sustain and enhance the quality of life. He or she recognizes a need to use the environment fully but also recognizes an obligation to pass it on to future generations with as little damage and as much improvement as possible.
- Demonstrates a willingness to curtail some individual privileges, and even rights to certain resources, for the long-range public good.
- Consciously limits the size of the family he or she engenders consistent with the limited resources of the biosphere.
- Works to maintain diversity in the total environment — both natural and man-made.
- Is continually examining and reexamining the values of his or her culture in terms of new knowledge about humankind and resources. The individual then seeks to change values and assumptions that are creating people-environment interactions disruptive to optimum development of human potential and the integrity of the ecosystem (Dickey and Roth, 1972).

Thomas Rillo (1974) referred frequently to the concept of environmental literacy but never specifically detailed it. Implicitly however he provided a working definition:

Environmental literacy on the part of the general public could precipitate pressure to slow down the pace of environmental change until the consequences can be scientifically, psychologically, and socially determined. Technology may be a major cause of the contemporary environmental predicament, but it is only one of the major causes, and it has the capability of solving the problems it creates. An environmentally aware and articulate citizenry could very well be the catalyst for technology's acceptance of its responsibility for quality in the living environment. After all, the public is the consumer of technology's productive efforts.

There is a need for *environmental assurance*. This assurance reflect the attitude that there is hope for a sanative environment and that mankind has both the desire and the capability of achieving it. What is desperately needed is the total involvement of millions of people in action programs leading to the solution of the environmental problems confronting modern society. However, apathy and *laissez faire* attitude continues to prevail with the majority of our population. It is so easy to slip into a state of pessimism and do nothing constructive toward the restoration of a quality environment for all. What is needed is an *aware, articulate*, and *activated citizen* who is willing to donate time, energy, and resources toward the solution of environmental problems. What is needed is a *framework of reference* which can help guide one in making wise decision in the struggle for a quality environment.

The major objective of environmental education is aimed at producing an individual who is motivated toward the rational use of the environment in order to develop the highest quality of life for all. Other objectives...include the basic understanding that man is not a separate form of life and completely independent, but that he is interrelated to resources both natural and cultural and to other forms of life around him. An individual should have an adequate understanding of the biophysical world including both the biosphere (natural environment) and the psychosphere (the man-made environment) and the role of these resources in contemporary society. He should have an understanding of how to identify environmental problems, how to solve these problems and the acceptance of responsibility for the solution of the problems as a basic civic duty.

Hungerford and Tomara (1977) in their work put an emphasis on action in their definition suggesting that the goal of environmental education is, "development of an environmentally literate citizenry, i.e. a citizenry that is both competent to take action on critical environmental issues and willing to take that action."

In 1984 Volk, Hungerford and Tomara reiterated and somewhat expanded this statement by suggesting that, "Environmental education is failing in its endeavor to develop knowledgeable, concerned, competent, and participating citizens, i.e., environmentally literate human beings."

Roth (1984) provided a more succinct statement of his earlier perception of environmental literacy along with some suggestions of how a process might be put in place to develop and maintain it. He said the task is to:

> Produce a citizenry that:
>
> a. Understands the self-regulating systems of our life-sustaining planet.
>
> b. Operate their lifestyles in congruence with those self-regulating systems.
>
> c. Work cooperatively to eliminate cultural activities that significantly disrupt the life-sustaining systems.
>
> Such citizens are considered to be environmentally literate.

In 1989 Rockcastle described environmental literacy as follows:

> Environmental literacy is an understanding, at some basic level, of the interaction of humans and their natural environment with regard to both living things and non-living things (air, water, soil, and rocks). The interaction implies taking from as well as putting into. It includes what humans do with, to, and for plant and animal life, as well as what plant and animal life does in response to human intervention. There is hardly a human activity that leaves no consequence to both the biota and Earth's mantle. The interaction includes short- and long-term subtleties as well as gross and obvious causes and results. Environmental literacy is an awareness and an understanding of the basic relationships in the interaction.
>
> There is a broad spectrum of environmental literacy, from total ignorance or unawareness to deep, thorough understanding and concern. There is also a broad spectrum of involvement and responsibility, from unintended carelessness and wanton disregard to personal dedication and life-long commitment. The vast majority of people are unaware, illiterate,ignorant of the most basic interactions between humans and the environment. They just never knew or thought about the byproducts of simply living, for example.

In 1989, McClaren put forth these elements of environmental literacy as a challenge to Canadian education for the next century:

1. The ability to think about systems.
2. The ability to think in time: to forecast, to think ahead, and to plan.
3. The ability to think critically about value issues.
4. The ability to separate number, quantity, quality, and value.
5. The ability to distinguish between the map and the territory.
6. The capacity to move from awareness to knowledge and action.
7. A basic set of concepts and facts plus the ability to learn new ones and unlearn the old.
8. The ability to work cooperatively with other people.
9. The capacity to use skills in eight processes: knowing, inquiring, acting, judging, opening, imagining, connecting, and valuing.

McClaren's view looks very broadly at the roots of education in general. It reaches to the very heart of human learning and is visionary in many ways.

Within the environmental education field there is fairly broad acceptance of the statement in the Tbilisi document (Federal Interagency Committee on Education, 1978) that says:

> An environmentally literate person has:
>
> 1. An awareness and sensitivity to the total environment.
> 2. A variety of experience in and a basic understanding of environmentally associated problems.
> 3. Acquired a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection.
> 4. Acquired the skills for identifying and solving environmental problems.
> 5. Opportunities to be actively involved at all levels in working toward resolution of environmental problems.

Although this statement is a useful starting place, it is full of many phrases that seem to demand clarification such as: *total environment*, *basic understanding*, and *set of values and feelings of concern*. In 1989, when announcing 1990 as International Environmental Literacy Year by the United Nations, the newsletter *Connect* (UNESCO-UNEP, 1989) offered the following broad, yet vague, conceptualization of environmental literacy:

> *Environmental literacy for all*, that is, a basic functional education for all people, which provides them with the elementary knowledge, skills and motives to cope with environmental needs and contribute to sustainable development. In other words, environmental literacy is conceived as *functional* literacy in the same sense that function–problems-solving, community participation–is considered the operating principal of environmental education. Similarly, the environmental movement itself, in becoming one of the most important of our time, is demonstrating its maturity by reaching out for political and *practical* responsibilities in the preservation *and* improvement of the environment, that is, the quality of life.

In 1990, United Nations' conferees further expanded on the Tbilisi document to state that environmental literacy, "is a basic functional education for all people, which provides them with the elementary knowledge, skills, and motives to cope with environmental needs and contribute to sustainable development."

Marcinkowski (1990), drawing heavily upon the research literature, alters and expands the Tbilisi document in this fashion:

> Environmental literacy involves:
>
> a. An awareness and sensitivity toward the environment.
>
> b. An attitude of respect for the natural environment, and of concern for the nature and magnitude of human impacts on it.
>
> c. A knowledge and understanding of how natural systems work, as well as of how social systems interface with natural systems.
>
> d. An understanding of the various environmentally-related problems and issues (local, regional, national, international, and global).
>
> e. The skills required to analyze, synthesize, and evaluate information about environmental problems/issues using primary and secondary sources, and to evaluate a select problem/issue on the basis of evidence and personal values.
>
> f. A sense of personal investment in, responsibility for, motivation to work individually and collectively toward the resolution of environmental problems/ issues.
>
> g. A knowledge of strategies available for use in remediating environmental problems/issues;
>
> h. The skills required to develop, implement and evaluate single strategies and composite plans for remediating environmental problems/issues.

i. Active involvement at all levels in working toward the resolution of environmental problems/issues.

This modification of the Tbilisi documents definition has played a key role in the process of refining and clarification of "environmental literacy" that is being undertaken in the 1990s. Ultimately the question remains, "What knowledge and behaviors constitute environmental literacy and to what levels of such literacy do we attach various behaviors?"

Part II: Operationalizing the Concept

Refining and Clarifying the Definition of Environmental Literacy in the 1990s

In the years since the term environmental literacy first emerged we have seen that there have been several formal interpretations of what it consists of, and there have also been a variety of other interpretations that have been perceived but not necessarily committed to publication. These varied interpretations have many areas of overlap which point to workable consensus and some differences that demand serious consideration. The term itself promises considerable usefulness in goal and objective setting for programs of many types if reasonable consensus on its meaning can be established.

To this end, the Environmental Literacy subcommittee of ASTM's TO4 Committee on Environmental Education has been developing such a consensus statement based on the formal literature and input from committee members and others in the environmental community using a modified Delphi process overseen by this writer. The completed document will be used to set forth guideline standards. Much of the material presented here detailing environmental literacy is derived from the results of this process as of spring 1991.

An Environmental Literacy Continuum

Society has a tendency to use the term literacy as if it were binary–either you are literate or you are not. In actuality, any type of literacy represents a continuum from zero ability to advanced skills.

It would appear that the presence or degree of any literacy can best be determined by observed behavior. Environmental literacy must likewise be defined in terms of observable behaviors. That is, people should be able to demonstrate in some observable form what they have learned — their knowledge of key concepts, skills acquired, disposition toward issues, and the like. In addition, any literacy may be seen to involve degrees of proficiency. These are actually points along a continuum ranging from inability to sophisticated competency. For example, the functionally literate reader is able to recognize the alphabet and can decode basic signs and key phrases or simple words, whereas a competently literate person shows extensive skill in reading, decoding, and comprehending a variety of complex writings. Similarly, environmental literacy presents a continuum of competencies of understandings, skills, and actions.

As with the achievement of reading literacy, there are stages of accomplishment along the way, i.e., ability to differentiate the characters of the alphabet, recognition that patterns of letters have meaning, etc. These have a rough correlation to what may be perceived as three levels of environmental literacy: nominal, functional, and operational.

At this point, we present a generalized statement of each of these levels. Later in the monograph more explicit detail will be provided.

Nominal environmental literacy indicates a person able to recognize many of the basic terms used in communicating about the environment and able to provide rough, if unsophisticated, working definitions of their meanings. Persons at the nominal level are developing an awareness and sensitivity towards the environment along with an attitude of respect for natural systems and concern for the nature and magnitude of human impacts on them. They also have a very rudimentary knowledge of how natural systems work and how human social systems interact with them.

Functional environmental literacy indicates a person with a broader knowledge and understanding of the nature of and interactions between human social systems and other natural systems. They are aware and concerned about the negative interactions between these systems in terms of at least one or more issues and have developed the skills to analyze, synthesize, and evaluate information about them using primary and secondary sources. They evaluate a selected problem/issue on the basis of sound evidence and personal values and ethics. They communicate their findings and feelings to others. On issues of particular concern to them, they evidence a personal investment and motivation to work toward remediation using their knowledge of basic strategies for initiating and implementing social or technological change.

Operational literacy indicates a person who has moved beyond functional literacy in both the breadth and depth of understandings and skills who routinely evaluates the impacts and consequences of actions; gathering and synthesizing pertinent information, choosing among alternatives, and advocating action positions and taking actions that work to sustain or enhance a healthy environment. Such people demonstrate a strong, ongoing sense of investment in and responsibility for preventing or remediating environmental degradation both personally and collectively, and are likely to be acting at several levels from local to global in so doing. The characteristic habits of mind of the environmentally literate are well ingrained. They are routinely engaged in dealing with the world at large.

Stages Of Environmental Literacy

Although there is a high degree of individual variation in sequencing, people tend to progress through the development of degrees of environmental literacy in stages that include:

• Awareness	Perception of human/nature interactions and consequences in general or around a particular issue. This may be emotional, cognitive or both.
• Concern	Perception of real or potential negative consequences of a set of human/nature interactions and a feeling that some changes

	in those interactions need to occur.
• Understanding	Acquisition of detailed information about the present and future implications and consequences of current human/nature interactions and alternative interactions.
	Acquisition of thinking and decision-making skills and their use in processing acquired information.
• Action	Application of understandings to individual and corporate behavioral changes that alter human/nature interactions in what is perceived as a responsible way that reduces or eliminates negative consequences.

It is important not to confuse capability at a particular developmental stage of literacy for achievement of the operational literacy itself:

> A person who is environmentally aware is not necessarily environmentally literate; nor is a person who possesses broad environmental understanding; nor is one who demonstrates great environmental concern; nor necessarily is one who takes action on environmental issues.

One demonstrates operational environmental literacy only when all the components come together in the actions taken. Environmental literacy is a synergistic response to integrated involvement of all the component pieces. However, people may be deemed functionally environmentally literate if their actions reflect all the components in only a few areas of human/environment interactions. Degree of environmental literacy is reflected in the breadth of human/environment interaction to which that person brings to bear all the skills and knowledges that define operational environmental literacy.

Achievement of operational environmental literacy in individuals is the ultimate purpose of environmental education. Indeed, one could define environmental education simply as education to develop environmental literacy and to foster development of environmental ethics. Hungerford, Peyton, and Wilke (1981) expand on this by implying in their definition of environmental education that environmental literacy involves becoming environmentally knowledgeable and skilled and dedicated to working toward, individually and collectively, achievement and/or maintenance of dynamic equilibrium between quality of life and quality of environment. With that in mind we should recognize that environmental education is more inclusive than such specialties as environmental science, environmental economics, environmental philosophy, or environmental law. It is quite possible to be well-versed in any one of these specialties, or even a combination of them, and still not be truly operationally environmentally literate.

Levels or Degrees of Environmental Literacy

Within the environmental literacy continuum it is useful to recognize 3 major levels of environmental literacy–nominal, functional, and operational–as briefly outlined earlier. In the sections below we describe the specific aspects of each level in general and in terms of the four major strands: knowledge, affect, skill, and behavioral. The items included in each strand have been factored out of many of the early definitions of environmental literacy and/or have been extracted from discussions of the ASTM TO4 Subcommittee on Environmental Literacy or correspondence through the modified Delphi Process being used by that group. It is truly a cooperative effort.

The Nominally Environmentally Literate

Nominal environmental literacy specifies a person able to recognize many of the basic terms used in communicating about the environment and able to provide a rough, if unsophisticated, working definition of their meaning.** Persons at the nominal level are developing an awareness of and sensitivity toward the environment along with an attitude of respect for natural systems and concern for the nature and magnitude of human impacts on them. They also have rudimentary knowledge of how natural systems work and how human social systems interact with them.

Knowledge Strand — *Nominally environmentally literate individuals are familiar with:*

- The nature of the basic components of elemental systems (e.g., living and non-living things, requirements for life).
- Types and examples of interactions between humans and nature.
- Basic components of societal systems.

Affect Strand — *have affective sensitivities about:*

- Appreciation of both nature and society.
- Elementary sensitivity and empathy for both nature and society.
- Elemental perceptions of points of conflict between nature and society

Skill Strand — *have skills of:*

- Identifying and defining problems.
- Recognizing issues surrounding identified problems or proposed solutions (e.g., latent and visible conflicts).

Behavior Strand — *demonstrate:*

- Familial, school, and youth organization activities and habits aimed at maintenance of environmental quality.
- Responding and coping behaviors.

** The Appendix contains of list of some basic terms nominally literate individuals might be expected to recognize with some degree of understanding. Further examples of basic concepts are to be found in Meadows (1989), Hanselman, et al (1989), or FICE-EE (1976).

The Functionally Environmentally Literate

Functional environmental literacy indicates a person with a broader knowledge and understanding of the nature and interactions between human social systems and other natural systems. They are aware and concerned about the negative interactions between these systems in terms of at least one or more issues and have developed the skills to analyze, synthesize, and evaluate information about them using primary and secondary sources. They evaluate a selected problem/issue on the basis of sound evidence and personal values and ethics. They communicate their findings and feelings to others. On issues of particular concern to them, they evidence a personal investment and motivation to work towards remediation using their knowledge of basic strategies for initiating and implementing social or technological change.

Knowledge Strand — *The functional environmentally literate citizen, in addition to the knowledge of the nominally literate, has knowledge of and understanding of a number of ecological, economic, geographic, religious, educational and political processes and understanding of the effects/impacts of humans on natural systems, including:*

- Population dynamics.
- Interactions.
- Interdependence.

- Limiting factors.
- Energy transfers, production, storage, and degradation.
- Biogeochemical cycling.
- Communities.
- Ecosystems.
- Succession.
- Homeostasis.
- Man as ecological variable.
- Uneven distribution of resources globally.
- Understanding dynamic relationships between science, technology, and society.
- Understanding of the process of scientific inquiry.
- Awareness of and concern about economic, social, political, and Ecological interdependence in urban and rural areas.
- Distinguishing between territory and map (a thing and its representation).
- Thinking in terms of systems.
- Thinking in terms of time frames or scales.
- Awareness of appropriate time/rate determiners for changes desired.
- Thinking critically and creatively.
- Consequences of individual actions.
- Human/personal impacts individually and collectively, in terms of an ecological perspective:
  - population.
  - political decisions.
  - energy sources and uses.
  - conservation.
  - waste streams.
  - recycling.
  - transportation.
- Human cultural activities influence the environment from an ecological perspective.
- Basic numeracy and scale.

Skill Strand

The functionally environmentally literate demonstrate basic skills in analyzing problems and issues and conducting investigations of problems and issues using primary and secondary resources/strategies such as:

- Identifying environmental issues.
- Seeking historical background of issues.

- Investigating environmental issues.
- Evaluating sources of information.
- Analyzing environmental issues from various perspectives.
- Applying ecological concepts to predicting probable ecological consequences.
- Identifying alternative solutions and value perspectives.
- Evaluating alternative solutions.
- Conducting basic risk analysis.
- Identifying and clarifying his/her value positions.
- Examining issues from local, national, regional, and international points of view.
- Thinking in terms of systems.
- Demonstrating ability to forecast, to think ahead, plan.
- Thinking critically and creatively.
- Distinguishing between number, quantity, quality, and value.
- Working cooperatively with other people.
- Acting.
- Judging.
- Valuing.
- Articulating personal values.
- Decision-making.

Affect Strand

The functionally environmentally literate demonstrate such basic affects, attitudes and values as:

- identification with, and feelings of concern for, both society and the environment.
- willingness to recognize and choose among differing value perspectives associated with problems and issues.
- internal locus of control.
- treating public and private property with equal respect.
- sense of stewardship.

Behavior Strand

The functionally environmentally literate moves to action through selected lifestyle activities/behaviors and community/organizational behaviors demonstrated by:

- Taking action positions and actions based on best available knowledge.
- Taking individual and/or group action through:
  - Persuasion.
  - Consumerism.
  - Political action.
  - Legal action.
  - Ecomanagement.

The Operationally Environmentally Literate

Operational literacy indicates a person who has moved beyond functional literacy in both the breadth and depth of understandings and skills and routinely evaluates the impacts and consequences of actions; gathering and synthesizing pertinent information, choosing among alternatives, and advocating action positions and taking actions that work to sustain or enhance a healthy environment. This person demonstrates a strong, ongoing sense of investment in and responsibility for preventing or remediating environmental degradation both personally and collectively, and is likely to be acting at several levels from local to global in so doing. For the operationally environmentally literate individual many, if not all, key elements of functional literacy have become habits of mind.

In addition to the knowledge, skills, attitudes and values, and actions of the functionally environmentally literate, the operationally literate demonstrate the following.

Skill Strand

Skills involved with evaluating problems and issues on the basis of available evidence (facts) and personal values and skills used in planning, implementing, and evaluating solutions, including:

- Using the process skills of scientific inquiry.
- Using ability to forecast, to think ahead, plan.
- Using ability to separate number, quantity, quality, and value.
- Imagining.
- Connecting.
- Valuing and value analysis.
- Using primary and secondary sources of information.

- Using ability to separate fact from opinion.
- Determining the roles played by differing human beliefs and values in environmental issues.

Affect Strand

Affects, attitudes and values that indicate a valuation of both nature and society, a sense of investment in and responsibility for the resolution of problems and issues along with a respect for both nature and society and a willingness to participate in, and show a sense of efficacy toward the resolution of problems and issues including:

- Awareness of and sensitivity to the total environment and its allied programs.
- Motivation to actively participate in environmental improvement and protection.
- Taking into account historical perspectives while focusing on current and potential environmental situations.
- Awareness of and sensitivity to the total environment and its allied programs.
- Strong internal locus of control.
- Personal responsibility:
  - recognition of impacts of personal behavior.
  - acceptance of personal responsibility for the impacts.
  - willingness to help correct or avoid negative impacts.
- Balancing love of nature with love of humanity.
- Willingness to curtail some individual short-term privileges for long range public good.
- Perceptual orientation movements from:
  - present to future.
  - society to humanity.
  - isolated phenomena to interacting systems.
- Personal environmental ethics.
- Respects diversity of human perceptions, learning styles and value systems.

Behavior Strand	*Actions that demonstrate leadership in working toward the resolution of problems and issues including:* • Evaluating actions with respect to their impact on quality of life and environment. • Providing verbal commitments. • Working to maintain biological and social diversity. • Continually examining and reexamining the values of the culture. • Making decisions based on beneficence, justice, stewardship, prudence, cooperation, and compassion.

Part III: Directions for the 1990s

Stimulating and Nurturing Environmental Literacy–Whose Responsibility?

Developing operational environmental literacy takes many years. Indeed developing a high degree of competence is a life long effort. The tendency in our culture is to delegate the burden of all such efforts to the schools but they are only one segment of our broader, though poorly integrated, educational system. It includes family, community, media, religious organizations, schools, interest groups, and the workplace. Each component of the total educational system has a role to play in the learning of all of us and thus in both stimulating and nurturing environmental literacy for all citizens.

All people, wherever they live and regardless of the culture in which they live, have impacts upon the environment. The consequences of their individual and collective activities have impacts upon the environment of varying intensities and valences. At any given point in time, the general quality of the environment is largely the net sum of the consequences of these individual and collective actions. To be sure, under some situations major natural catastrophes such as earthquakes and violent storms may alter the environmental quality, but the net sum equation has a basic validity.

A corollary of that equation is that the more people there are with even elementary environmental literacy the better will be the quality of the environment; the greater the number of people with even greater degrees of environmental literacy the better still. This sets the task of stimulating and nurturing environmental literacy at the doorstep of all components of our very loosely articulated general education system. Actually, in differing cultures, different components are more effectively integrated than in others

Different components of the broad educational system vary in their degree of influence on individuals at different times during their life cycle. This writer's Figure 1 provides a general indication of this. The shapes of the shading within each column in Figure 1 are not precise but are broadly drawn based on information from a range of articles and research on the human life cycle and the factors that affect learning of individuals at various stages in that life cycle.

Currently only a few of the components perceive their role and actively accept responsibility for contributing to individual's development of environmental literacy. A task that faces the education community in the coming years is to change this. Schooling, at the elementary and secondary levels, is most widely perceived to have a responsibility to developing environmental literacy. Progress is being made along these lines and a number of state educational agencies have established general goals for environmental education that have many of the aspects sought in some degrees of environmental literacy. A few states, like Wisconsin, have even established environmental education standards for the preparation of teachers in several instructional categories (Engleson, 1985). There are also several federal initiatives to promote environmental literacy through schools (Council on Environmental Quality, 1991). However, schooling can, and should, bear only a reasonable proportion of the overall task.

Interest groups, such as scouting, nature centers, environmental organizations and museums have over the past few decades carried a large share of the effort, at least in the

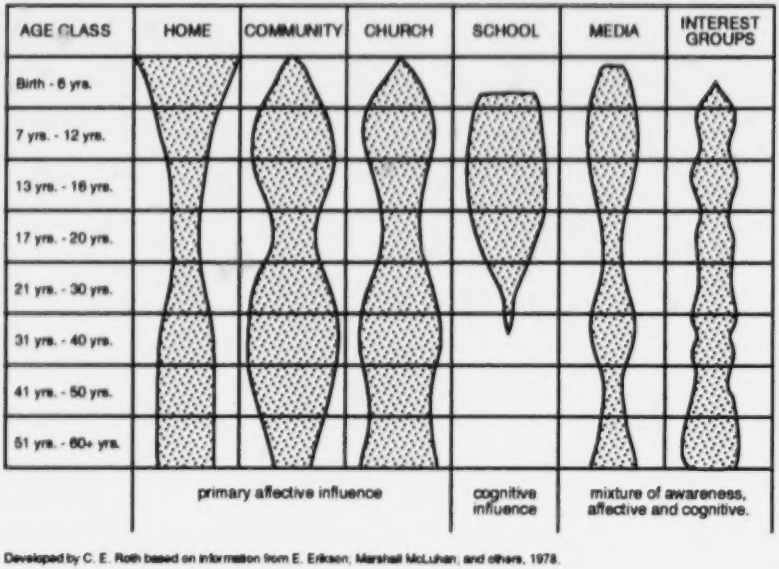

Figure 1 The Overall Education System and the Relative Influence of its Components at Various Periods of the Human Life Span.

United States. This has been accomplished largely with volunteered time and private donations and grants. The state, local, and federal funds that support schooling have played a minor role with the interest groups.

The media, since the late 1960's have played an increasing role in bringing environmental information to the attention of the public in text and visuals and has had a strong influence on public attitudes. It is less effective in developing other aspects of environmental literacy

> In Australia, England, and Israel, where student's sources of knowledge were also investigated {U.S. part of this study}, the mass media were the most important source. This influenced students' judgment in the seriousness of different environmental issues.
>
> The review showed that school was less common as a source of environmental information than the mass media, although the investigation was conducted on students in school (Blum, 1987).

In recent years, religious institutions have begun to rethink their role in contributing to environmental literacy. The efforts have been spotty and vary with different denominations but progress in some cases is quite encouraging.

The family, community, and workplace levels have arguably taken the least broad-based active roles in the overall task of stimulating and nurturing environmental literacy.

Suggesting that stimulating and fostering environmental literacy is a task that falls to all these components runs the risk of the old shibboleth–what is everyone's responsibility becomes no one's. However, because environmental literacy represents a broad continuum over considerable time, it becomes a necessity that all the components of the "broad educational system" become involved in appropriate ways to contribute effectively to each individual's development. That is, it is important that we find ways to make the components function more effectively as a truly integrated system instead of the loose confederation of educational components that currently exist.

I believe that an important first step is to get school policy makers to accept and publicly articulate the development of appropriate degrees of environmental literacy as a basic general objective of formal education — primary, secondary, and post-secondary. The next step is to put in place appropriate, effective programs to achieve that objective. Over the past two decades a great many programs have been developed, several have received relatively broad acceptance. In only a few places, however, have the multi-year, multi-disciplined programs, needed to foster more than nominal environmental literacy, been put in place. Currently, the state of Wisconsin seems to have the most broad-based, statewide program in place with a commitment to goals that encompass much of what is needed to develop at least functional environmental literacy.

A second step is to get the media to accept a similar objective and to take steps to assure that the people who do the communicating are themselves of good competence in environmental literacy so that they can communicate appropriate information to their audiences.

With these two steps operational the stage is set for other components of the general education system to shoulder similar responsibility where feasible. Knowledge, beliefs, attitudes, and actions that emerge from only one component of the broad education system are apt to be dealt with only within the particular context of that component and not in other areas of life. When such knowledge, beliefs, attitudes, and actions are reinforced in the contexts of other components of the broad education system they are much more likely to become normative. I believe that it must become a major task of society to see that a reasonably advanced degree of environmental literacy becomes normative to societies around the globe.

Environmental Literacy and Higher Education

Since we are dealing with a continuum of development with people entering the process at various entry points in their overall education and progressing into ever greater competency, developing environmental literacy is a task for all levels of education. Recently ever more institutions of higher education have been addressing their role and responsibilities in nurturing environmental literacy within their student bodies.

In April of 1990 undergraduate faculty teams from eight of the Pennsylvania State System of Higher Education universities, along with representatives from the Ohio Department of Education and Kent State University, participated in a workshop/forum where the participants pooled their experience and drafted guidelines for undergraduate university programs that are designed to lead to environmental literacy (Chase, et al., 1990).

In 1989, Rockcastle speaking to the Pennsylvania Environmental Programs Association asked the rhetorical question:

> How can environmental literacy be accomplished? Not by a course. Not by decree. But by sustained, campus-wide, overt introduction of small but real environmental examples, analogies, problems in courses, and the intentional relating of coursework to the personal lives of students. When education has environmental relevance for students, when students become convinced of the consequences of their actions, when they value what they are in danger of losing, then environmental literacy may be realized.

Almost as if they were heeding Rockcastle's remarks, Tufts University, in Massachusetts, has embarked on a very broad mission. According to Dean Anthony D. Cortese (1990):

> Tufts University has embarked on an ambitious program to develop the intellectual capital that is needed to meet human needs and many of our wants in an environmentally sustainable manner in the future.

> This program seeks to have all graduates of Tufts University–in the college of liberal arts and engineering, the schools of medicine, veterinary medicine, dentistry and nutrition, the Fletcher School of Law and Diplomacy and the graduate school of arts and sciences, be environmentally literate and responsible citizens. Through broad, continuing and repetitive exposure to environmental issues throughout the educational experience at Tufts, we will strive to develop a fundamental awareness and understanding that all human activities are dependent on a clean, healthy, and productive environment. We will strive to create an understanding of how we can protect the environment as we live and have a sense of stewardship for the planet.

To develop the program Tufts has established the Tufts Environmental Literacy Institute to work with the faculty to develop their skills to carry out such a program. Asking "What should informed citizens and professionals know about the world we live in and how human activities affect the world to be *environmentally literate*?," Cortese (1990) stated "We believe that fundamental knowledge, skills, and attitudes for an environmentally literate society would include the following:

> A basic understanding of the biosphere–the air, water and land–as the life support systems on which all living organisms depend for habitability and survival.
>
> An ecological perspective of nature and human beings, including concepts of carrying capacity, adaptation, and evolution.
>
> An historical perspective on environmental changes caused by nature and human society with special emphasis on the rapid changes brought about by industrialization, urbanization, and population growth since the mid-19th century.
>
> An understanding of the difference between hazard and risk as well as between actual, potential, and perceived risks from contamination and destruction of the environment, and natural resource consumption.
>
> A basic understanding that the ways we organize ourselves as families, communities and national entities, and the activities we choose to meet human needs and wants, affect our health, the environment and the quality of life. Exploration of how culture, social and political organizations and the stages of development of groups of people contribute to these effects.

> An exploration of the ethical issues involved in environmental protection and management including: (i) the distributive justice and moral issues surrounding science, technology, and human organization, and activities; (ii) the intervention strategies utilized to manage and protect humans and the natural environment; and (iii) the judgments and decisions of environmental management professionals.
>
> An exploration of decision making on environmental issues in scientific, economic, legal, social and political contexts as well as in the face of scientific and other uncertainties.
>
> An awareness of how individual decisions affect the health and quality of life of other people and living species, and actions that individuals can take to protect the environment and public health.
>
> An awareness of the sources of information and expertise on environmental issues. Ability to read and understand newspaper and journal articles on environmental issues. Sufficient skills to engage in scientifically and culturally informed discussions on environmental issues in the communities in which individuals live and work.

The ideas outlined above are clearly encompassed in earlier discussion of what composes environmental literacy but the focus is on the more sophisticated levels of environmental literacy as is to be expected. What is unique here is a university's willingness to set this as a goal for virtually all its students in all fields.

Tufts appears to be the first to have moved as far in implementation of such goals but others are perceiving the need and moving toward making the appropriate changes. For example, in 1989, Dr. Knapp, President of the University of Georgia addressing the faculty and students stated:

> With regard to curriculum, I submit to you that we can no longer afford to grant degrees to students who are environmentally illiterate....I will be asking the faculty and my administration to consider basic policy changes in three separate areas that will address the University's ability to address environmental issues: curriculum, organizational structure and financing....I will be charging the curriculum committee of the University Council to study and make recommendations regarding changes in the University's curriculum that will be necessary to promote environmental literacy.

It can only be hoped that such thinking is the beginning of a trend that will reach far across the face of higher education.

Assessing Environmental Literacy

A major question that must be dealt with is how can we assess environmental literacy. Relatively little work has been done along these lines. That should not be surprising since until very recently there has been little clear definition about what such literacy is. The Wisconsin legislation on Environmental Education calls for such education to improve the environmental literacy of the Wisconsin citizenry and calls upon the appropriate agencies to assess periodically the environmental literacy of people in the state to determine if the legislation is doing its job. As of 1991 efforts to develop the tools to undertake such assessment were under development, but not yet implemented and validated. The process for Wisconsin is itself hampered by lack of a clear-cut definition of what constitutes environmental literacy. No definition is included in the legislation.

The Wisconsin group is pressing ahead and attempting to pull together any existing research materials that may help them in their effort. Most of the existing instruments address only a narrow aspect of environmental literacy such as attitudes or cognitive skills. Most were designed for a one-time, specific use and do not lend themselves to ongoing assessment. The most useful research paper for them to date is Assessment of Learning Outcomes in Environmental Education (Iozzi, 1990). Wisconsin plans to assess environmental literacy among students two grade levels and among teachers (Champeau, 1991). The Wisconsin effort is truly a pioneering one, and one to be watched and learned from.

In Indiana attempts have been made to assess the environmental literacy of teachers and any changes in that literacy level between 1975 and 1985. Buethe and Smallwood (1987), who conducted that study, focused their efforts on teachers' familiarity with environmental and related terminology that these researchers equate with environmental literacy. In attempting to establish a baseline of teacher environmental literacy they developed an instrument that dealt with three key questions:

1. What important environmental vocabulary is known/unknown by teachers?
2. How well known are environmental concepts that are directly related to the chosen vocabulary?
3. What are teachers' feelings about selected environmental issues?

In terms of what is presented as environmental literacy in this monograph, that study focused only on limited aspects of nominal environmental literacy. The hope is that those in a teaching role will have a somewhat higher level of environmental literacy, yet even within the limited definition of their study, Buethe and Smallwood (1987) concluded:

> The overall energy/environmental literacy in Indiana teachers appears to be low. However, gains have been made over the past decade. As expected, science teachers had significantly higher scores than other teachers on both vocabulary and concept tests...scores of science teachers were 1/5 higher than those of social studies teachers.

As the term environmental literacy is better clarified and levels of such literacy established and sought in specific environmental or general education programs, it should be possible to develop instruments that more effectively and accurately assess achievement of various levels of environmental literacy. Such instruments will permit the field to assess the effectiveness of various programs in given contexts and for specific audiences and help determine the relative cost effectiveness of proposed and operant environmental education efforts.

In addition to assessing the level of environmental literacy attained by individuals there is need to assess the efficacy of programs to develop and nurture such literacy. At local school levels it is necessary for citizens to assess what is or is not being done and to take action to remediate deficiencies. One can begin by developing assessment checklists to explore the local school system. Such a checklist would include such things as:

- At what grade levels and in what subjects are topics dealt with that promote environmental literacy?
- Is there any coordinated curriculum effort to develop such literacy?
- What direct, reflective, experiences with natural and built environments (field trips, residential outdoor programs, walkabouts, etc.) are provided?
- What percentage of the budget is specifically allocated toward developing environmental literacy?
- Are teachers prepared to foster environmental literacy in their students?
- Do textbooks currently in use provide basic information for developing environmental awareness?
- How well is the school or public library stocked with materials that will foster environmental literacy?
- What environmental problems exist in the community or region today in large measure due to environmental illiteracy in the past? (Roth, 1984).

Clearly, additions should be made to such a list; it does, however, provide a jumping off place for assessing the state of education for environmental literacy in the schools of almost any community.

New strategies for assessing the progress of both youngsters and programs are being developed around the country that promise greater validity, humaneness, and usefulness than the present crop of testing procedures that rely heavily on multiple choice and evaluate content much more effectively than the processes and skills that are equally important components of both environmental and scientific literacy. It is reasonable to look to these new strategies in developing the requisite assessment procedures for environmental literacy.

Afterword

The concept of *environmental literacy*, as more sharply and specifically defined, offers considerable promise for program goal setting in environmental education. Undoubtedly, future workers will be able to develop more concise working definitions of environmental literacy that will prove useful in general communication. However, I believe that for program development, the more detailed statement will allow workers to determine those aspects of a developing environmental literacy that they can appropriately address with their client population within the contact time that they have with those particular individuals. No individual instructor, or program, can do the whole job of developing an individual to highest levels of competency in environmental literacy, but each can deal with significant components. We all need to be able to recognize and accept the limitations involved in how far we can help advance any given individual while accepting the challenge of doing effectively all that we can within those limitations.

Considerable effort needs to be extended to get each of the components of the "broad education system," discussed earlier, accepting as part of their respective missions the fostering and nurturing of environmental literacy. If each does a more effective job of nurturing environmental literacy within the opportunities provided, increasingly more individuals will achieve higher degrees of competency on the environmental literacy continuum.

More work still needs to be done to even further refine the components of environmental literacy. The refinements need to be keyed to general developmental levels in formal education and the opportunities provided by nonformal education.

Much work lies ahead, in the 1990s and into the next century, to develop programs that will not only initiate individuals to the beginning levels of environmental literacy but will keep them moving along the continuum to the level of operational competency. Achieving a high proportion of this nation's population as operationally environmentally literate will not enough, this must be a global initiative, as idealistic as that may sound. The planet undoubtedly can survive without our species but we cannot survive without the life support system of the planet. If environmental illiteracy burgeons more rapidly than environmental literacy, it is reasonable to doubt the survival of human civilizations and to expect ever increasing amounts of human suffering.

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Appendix

Some Terms and Concepts Understood By Environmentally Literate Citizens

• environment	• ecology	• ecosystem	• system
• food chain	• food web	• limiting factor	• photosynthesis
• water cycle	• watershed	• evaporation	• condensation
• precipitation	• ground water	• water table	• leaching
• species	• herbivore	• carnivore	• omnivore
• scavenger	• parasite	• biological potential	• environmental resistance
• population	• carrying capacity	• sustainable yield	• extinction
• interactions	• interdependence	• diversity	• birth rate
• mortality rate	• dynamic	• competition	• resource equilibrium
• resource	• development	• land use management	• sustainable development
• production	• consumption	• growth	• depletion
• scarcity	• costs	• benefits system	• market & price
• amenities	• stocks of goods	• energy	• solar energy
• nuclear energy	• power	• entropy	• conduction
• convection	• radiation	• fission	• fusion
• half life	• atom	• concentration	• conservation
• weather	• climate	• global warming	• greenhouse effect
• oxygen	• carbon dioxide	• smog	• ozone layer
• acid rain	• weathering	• erosion	• thermal inversion
• siltation	• land use	• solid waste	• toxic waste
• septic tank	• sewer	• leach field	• saturation
• aquifer	• pollution	• nutrients	• irrigation
• desertification	• desalination	• pesticides	• endangered species
• decomposers	• wildlife	• microbes	• sanitary land fill
• fisheries	• forestry	• clear cutting	• biological control
• genetics	• mutation	• gene pool	• legislation
• regulation	• ethics	• trade offs	• paradigms
• world views	• life styles	• models	• appropriate technology
• capital	• interest	• biocentricity	• exponential growth
• stability	• instability	• anthropocentric	• natural heritage

(continued)

- strip mining
- industrialization
- agriculture
- adaptation
- urban
- regional
- green revolution
- niche
- suburban
- succession planning
- famine
- pH
- rural
- environmental quality
- parts per million (ppm)

The nominally environmentally literate will also have at least a nodding recognition of some major environmental events such as:

- Love Canal
- Earth Day
- Bhopal
- Aswan Dam
- Chernobyl
- polar ozone holes
- Exxon Valdez